



Decontamination of Aircraft Interiors

Stefanie Smallwood¹, David J. McGarvey¹, Ph.D., Joseph Myers¹, Michael Chesebrough², David Gehring¹, Kevin Morrissey¹

¹U.S. Army DEVCOM Chemical Biological Center, Aberdeen Proving Ground, MD, ² DCS Corporation, Riverside, MD

OBJECTIVE

Operators of aircraft require methods of returning an aircraft to service following contamination by a chemical weapon. As small amounts of chemical agents may prove to be fatal, high efficacy is critical. Aircraft can contain sensitive electronics, as well as other materials that might be damaged by caustic or corrosive decontamination materials, so an ideal system will minimize damage to these parts, and to the aircraft hull. The decontaminants used should also contain low-toxicity materials, as residual materials in a confined space may prove hazardous to the crew. Pilots and other personnel would benefit from a decontamination system that could be used with minimal training, and minimal equipment. Contamination may occur in a location where delivering specialized equipment and personal may present a logistical challenge.

Providing a capability that balances these often-conflicting constraints is a significant challenge for researchers developing these capabilities. This report outlines a number of approaches to these challenges.

Traditional decontamination approaches

Many decontamination systems have been developed to decontaminate large equipment. The chemical solutions used for these purposes often contain harsh chemicals that may work well on very rugged equipment. One standard solution, Decontamination Solution 2 (DS2), contains sodium hydroxide, diethylenetriamine, and ethylene glycol monomethyl ether. This very high pH solution can damage relatively rugged materials. Super tropical bleach (STB, containing concentrated chlorine bleach) and calcium hypochlorite (HTH) can also damage many materials.



DEVCOM CBC @ DTRA CBD S&T Conference

Scan the QR Code to view all of CBC's
2024 DTRA CBD S&T Conference materials
<https://cbc.devcom.army.mil/cbdst-conference/>

Milder Chemical Decontamination Solutions

More recent decontamination solutions have been developed that are less damaging to equipment, and present easier logistical burdens due to their lower corrosivity, though a number do still have flammability characteristics that are less than ideal. Examples of these include Decon Green (a mixture of hydrogen peroxide, carbonate/bicarbonate and cosolvents), and Dahlgren Decon (peracetyl borate, surfactants and a small amount of sodium hydroxide to neutralize the pH). While significantly less corrosive, using these chemicals on the interior of aircraft still raises questions about the future performance of electronic and other delicate components.

Chemical Hot Air Decontamination (CHAD)

CHAD is a decontamination process that may be able to provide the capability needed to effectively decontaminate an aircraft interior without compromising the future performance of the aircraft. This system uses hot, humid air that slowly flows through an enclosed space, and removes or detoxifies contaminants. Under temperature-controlled situations, the water remains in the vapor state and does not deposit liquid water on the assets.

– Temperature: 170°F (76.6°C)

– 2 air changes per hour

• Starting challenge: 1 g/m²

• Aging time: 24 h

• Pre-treatment: soapy water immersion (CARM)

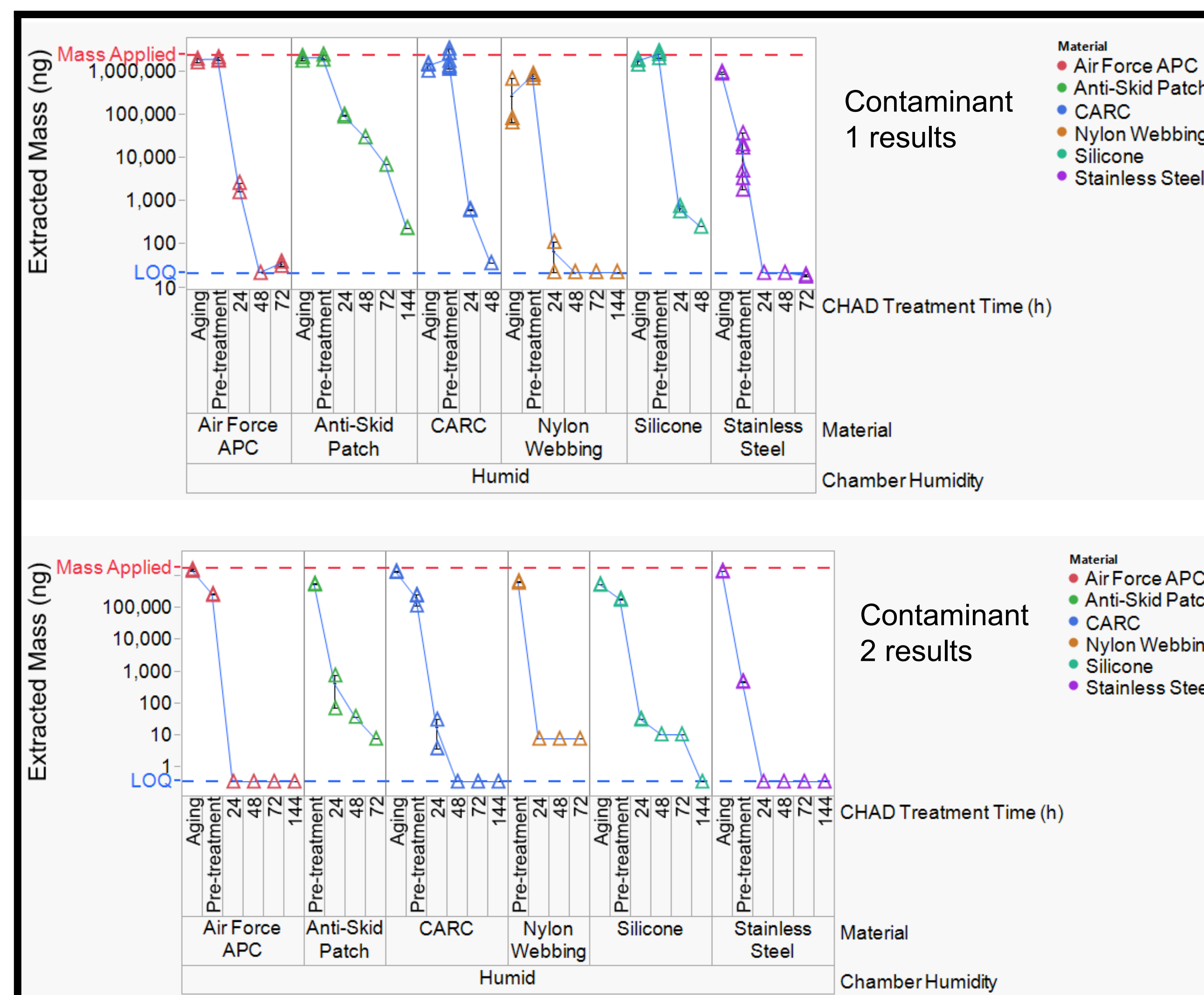
• Humidity: ~25%RH @ 170°F (~63.901 g/m³ ABS humidity)



• Thermotron Chamber (model # S-1.0-8200) was used inside a laboratory fume hood to ensure operator safety.

• Computer control, ability to control temperature and humidity ramping (eliminate possibility of condensation → mold)

Initial Study Results



Aircraft Study Test Parameters

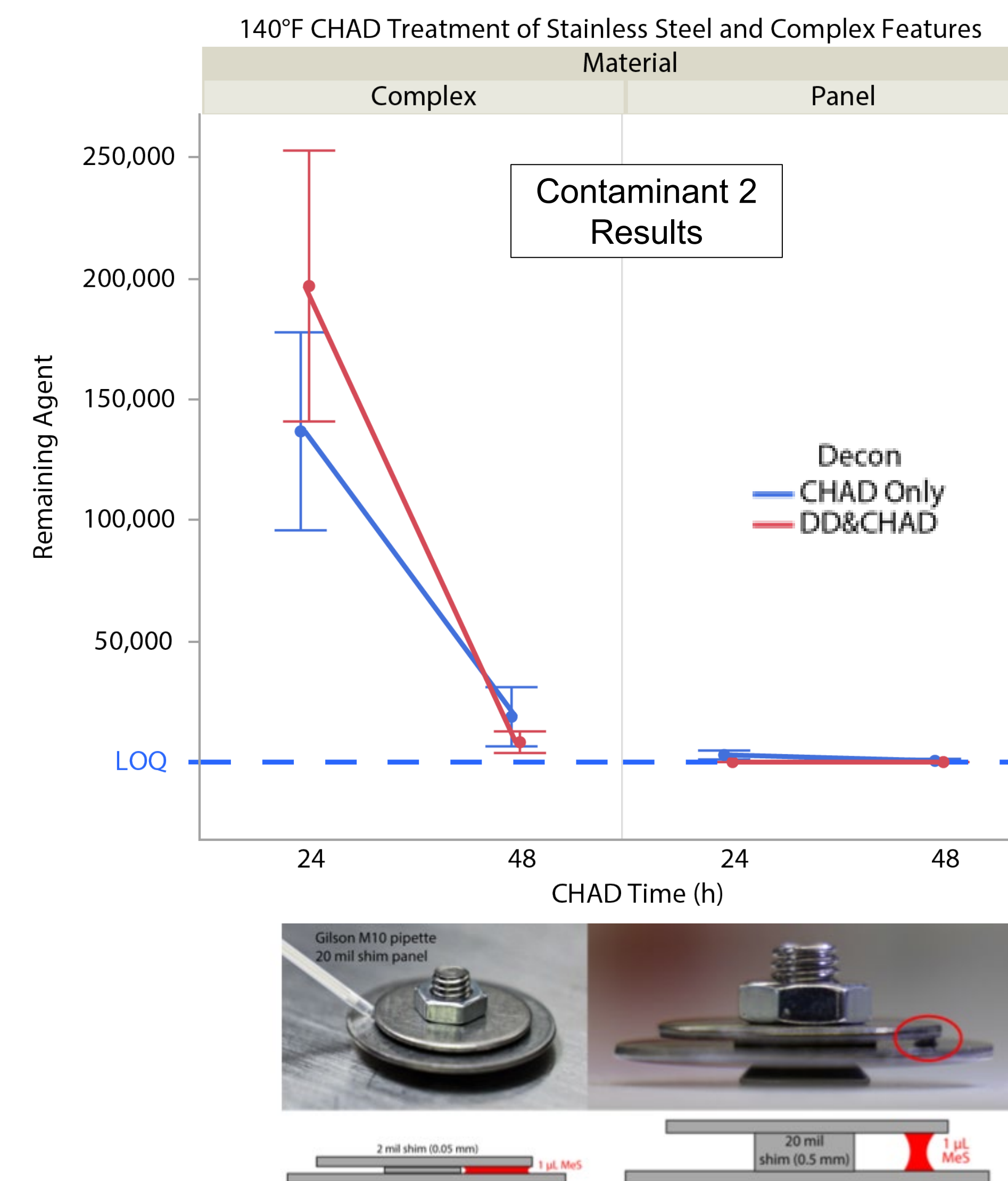
In order to design effective thorough decontamination for aircraft interiors certain desired properties were kept in mind:

1. Approvable for aircraft interior use
2. Will not harm aircraft electronics or other parts
3. At least 2-log reduction in agent concentration
4. Ideally completed in a 24 h time-frame, but 48-72 h is acceptable

High temperatures inside the aircraft can become detrimental to the interior systems needed to perform normal flight functions. 140° F is considered an acceptable temperature to bring the interior of the aircraft to, while allowing functionality of the aircraft after decontamination. With this consideration, the test parameters for this study were:

- Materials: Stainless Steel 314B (Panel), Complex Stainless Steel Feature (Complex), n=5
- Contaminant: 2uL drop of Contaminant 2
- Agent aging time: 24 hrs
- Decontaminant Conditions: Dahlgren Decon (applied 15 minutes after agent application using the German fog booster), Chad Only (no Dahlgren Decon application)
- CHAD Chamber Settings: 140° F, 95% humidity, 1.6L minimum flow rate (2 air changes per/hr)
- CHAD time: 24 hrs, 48 hrs
- Extraction time: 24 hrs in Isopropyl alcohol

Interior Aircraft Decon Study Results



Conclusions

Aircraft interiors represent an important and challenging environment for the decontamination of chemical agents. The combination of the variety of materials present, the complexity of assembled components, the delicate nature of some components, and the need for very thorough decontamination to prevent injury to the aircraft crew or maintenance personnel mean that any decontamination system must perform at a high level to be considered an acceptable solution.

Chemical Hot Air Decontamination (CHAD) may provide a path forward that can meet these demands. The materials compatibility from using warm, moist air is very acceptable. These preliminary data indicate that the efficacy of the system is very high against several matrixes, including the complex stainless steel feature, which is often one of the more difficult matrixes to decontaminate.

Additional research is needed to expand the number of agents tested, and other materials that may be present in the aircraft. Eventually, a full-scale test on an aircraft will be needed to show the viability of this system in a field-relevant environment.

Acknowledgements: R&D funding for this project was provided by JSTO (Glenn Lawson and Chuck Bass). The views expressed in this abstract are those of the authors and do not necessarily reflect the official policy or position of the Department of Defense or the U.S. Government.)



- Flat Stainless Steel Panels that were decontaminated with Dahlgren Decon before entering the CHAD chamber resulted in data near the analytical LOQ (limit of quantitation) or lowest amount of agent that could be quantitated. This was across both 24hr and 48hr CHAD times.
- Flat Stainless Steel Panels under the CHAD only conditions recovered 0.15 and 0.03% of the initially applied agent after 24 and 48 hrs respectively.
- Complex features that were decontaminated with Dahlgren Decon before entering the CHAD chamber recovered 9.93% and 0.41% of the initially applied agent after 24 and 48 hrs, respectively.
- Complex features decontaminated with CHAD only conditions recovered 6.9 and 0.95% of the initially applied agent after 24 and 48 hrs, respectively.